Pollution Prevention Case Study	**Quad/Graphics, Inc.** **Solvent Recovery System for Ink Jet Printing Operations**
Standard Industrial Classification (SIC)	Commercial Printing/2752,2754
Type of Waste	Methyl Ethyl Keytone (MEK) - Volatile Organic Compound (VOC) air emissions
Strategy	Recover, condense, and reuse VOC based solvent vapors with a Solvent Recovery System (SRS)
Company Background	Quad/Graphics, Inc. is a Pewaukee based, privately owned printer, founded in 1971. The company produces magazines, catalogs, Sunday inserts, and direct mailings. Quad employs over 8,500 workers nationally of which 6,800 are located in Wisconsin. In 1991, the company received a Governor's Award for Excellence in Hazardous Waste Reduction and in 1993 a Governor's Waste Reduction and Recycling Award. Quad/Graphics also is listed as one of the top 100 companies to work for in America.
Original Process	Ink jetting is used to print addresses, codes, and messages on magazines and catalogs. This process generates ambient MEK vapors from the highly volatile ink used to ensure a short dry time. The ink jet printing engines employ a print head which has a droplet generator from which multiple continuous streams of ink are emitted under pressure. The droplets of ink are charged and deflected by an electric field into a gutter for ink collection or onto paper or other medium. The ink in the gutter is drawn by a vacuum pump back into the ink supply tank where it is entrained in air vented from the ink supply tank.
Motivation	Quad/Graphics recognized that vapor lost as a fugitive emission could be recovered using a cooler/condenser process. Quad/Tech, a subsidiary of Quad/Graphics that manufactures press and bindery control equipment for the printing industry, has further advanced the technology. The motivating factors for the project were to achieve environmental benefits and economic and energy savings
Pollution Prevention Process	The Solvent Recovery System (SRS) collects fugitive MEK process vapors (otherwise lost to the environment) and cools them in a condensing unit. The unit recycles the vapors to a liquid that is recirculated and reused in the ink jetting process.
Stage of Development	The system is currently in the prototype phase and is being tested in six Quad/Graphics printing plants. Quad/Graphics plans to fully implement the process on all of its binding lines and partner with other printers for beta testing sites. The company plans to eventually make the system available for sale to other printers and industries.

Material/Energy Balance	***Original Process*** **Feedstock** 98,000 pounds per year of MEK fluids (inks and solvents) used in ink jet printing. **Waste** VOC air emissions from MEK fluids. 56,000 #2 grade plastic containers difficult to recycle due to ink residue. **Disposal** Plastic containers taken to landfill. **Energy** The transportation and manufacture of inks used in the printing process required the use of 2.867×10^{10} BTUs at a cost of $335,869/per year. ***Pollution Prevention Process*** **Feedstock** MEK-based fluids (inks and solvents) reduced by ~50%. **Waste** The SRS system recovers and reuses 80-90 percent of VOC vapors. Using the SRS system on all binding lines will result in a minimum reduction of 49,000 pounds of toxic air pollutants. This process also eliminates 28,000 #2 grade plastic containers that would require handling and disposal. **Disposal** Plastic containers taken to landfill. **Energy** Quad will save 2.867×10^{10} BTUs of energy and ~ 335,869 each year from the greatly reduced need to manufacture and transport ink.
Economics	**Capital Costs** The capital cost of an SRS unit is approximately $8,000. One unit is needed for each ink jet print engine. Quad uses over 200 of these engines. **Operation/Maintenance Costs** Expenditures for ink and solvents are reduced by 50 percent. This will result in a minimum savings of $552,000 per year. In addition, downtime on binding lines also is decreased. The resulting savings are $3 million from increased productivity and $1.2 million from reduced labor costs. **Payback Period** The payback period is less than three months.

Benefits	Benefits include: a 50 percent reduction of MEK-based ink and solvent; use, recovery and reuse of 80-90 percent of VOC vapors; reduction of down-time on binding lines; increase in productivity; reduction in the amount of plastic containers to be handled and disposed of; possible avoidance of add-on control equipment and air permits, therefore, saving on energy, end-of-pipe control equipment costs, and administrative costs resulting from greater regulation of hazardous air pollutants.
Obstacles	Obstacles encountered were: the cost of research, development, testing, and marketing; commercialization of a new technology; and worker skepticism and unfamiliarity with the new equipment. Quad received a cost-sharing grant from the National Industrial Competitiveness through Energy, Environment, and Economics ($NICE^3$) Program to help offset these costs.
Technology Transfer	This technology can easily be transferred to other printers through the marketing and commercialization efforts of Quad/Tech. Applicable changes would be needed to modify the SRS units to work compatibly with ink-jet print systems from different manufacturers and (or) using poly-alcohol based ink and solvent.
Other Pollution Prevention Activities	The company has implemented a wide variety of additional pollution prevention efforts. Examples of these include: • Inks produced by the ink manufacturing division, and used by the pressrooms, are enviro-friendly inks. These inks use combinations of corn, linseed, and soybean oil. These renewable oil resources, in part, replace petroleum-based oils. The resulting formulations meet and exceed the minimum requirements set by the American Soybean Association. Secondly, the formation of VOCs is reduced by increasing the amount of solids used in the ink and using a greater percentage of renewable resources. • In prepress operations, a filmless printing plate is used, to avoid the production of film and use of chemicals in the process. • Ink waste has been reduced by 40 percent; from 762 to 460 drums between 1989-1994. (Note that figures represent absolute, not relative reductions. Production increased 111% during the same period.) • The pallet repair department remanufactures broken pallets and makes mulch out of those that are beyond repair. In 1994, this department repaired over 96,000 pallets and produced over 600 tons of landscape mulch. • The pressrooms use reusable oil mats for leaking presses. In order to reuse the mats, each press crew wrings out their mats with a wringing machine. The oil is recycled and the mats are reused. This system has reduced oil mat consumption by 85% and saves the company in excess of $47,000 per year.

Company Address	Quad/Graphics, Inc. W224 N3322 Duplainville Road Pewaukee, Wisconsin 53072
Contact Person	John R. Imes, Environmental Manager 414/246-2080
Pollution Prevention Resources	**Free, On-site Technical Assistance** University of Wisconsin Extension Solid and Hazardous Waste Education Center Milwaukee area: 414/475-2845 Remainder of state: 608/262-0385 **Pollution Prevention Information Clearinghouse** Wisconsin Department of Natural Resources Cooperative Environmental Assistance 608/267-9700 or e-mail: cea@dnr.state.wi.us

Bureau of Cooperative Environmental Assistance
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707
608/267-9700

PUBL-TS-054 96